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EFFECT OF LOGGING ON BREEDING BIRD DIVERSITY IN RIPARIAN FORESTS ON FALL RIVER WILDLIFE AREA

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It has been demonstrated that logging can increase breeding bird densities (Conner and Adkisson 1975, Webb et al. 1977, Whitcomb et al. 1977). The objective of this study was to determine the impact on breeding birds of selective logging of two riparian forest tracts.

STUDY AREAS AND METHODS

This study of four riparian mixed hardwood forests was located on Fall River Wildlife Area in Greenwood County, Kansas. Areas 3 and 4 were selectively logged in the spring of 1985. The harvest was primarily hackberry (*Celtis occidentalis* with dbh (diameter at breast height) ranging from 35-55 cm. Selective logging was used to reduce competition, increase crown growth, improve the understory by creating canopy openings, and to increase mast production. Fifty-three trees were harvested on area 3, and 160 trees on area 4. Areas 1 and 2 were left undisturbed as controls. It is important to note that spring wildfires affected area 4 in 1987 and 1989, and area 1 in 1991.

— Breeding bird populations were sampled on the four study tracts from mid to late June for three years. Three sampling stations were located on each tract a minimum of 25 meters from the forest edge, and approximately 100 meters apart along an imaginary line through the center of each tract. The counting of birds began at 5:45 a.m. Fifteen minutes were spent at each station watching and listening. When the third station was completed, each station was immediately sampled again. Each tract was visited two mornings, a total of twelve 15-minute surveys.

In 1990, vegetation was sampled using Noon's methods (1981) to determine canopy cover and density of the understory. Vegetation sampling of each tract was done in a 0.04 hectare (ha) circular plot located at each of the three sampling stations.

Measuring forest size was difficult because the riparian study tracts are not well defined or isolated. An attempt was made to include adjacent forest habitat by measuring the amount of forest in a 50 ha circle centered at each of the study areas.

RESULTS

Area 1 (undisturbed) — Percent canopy cover was highest in this tract and understory density was significantly lower than the other study tract (Figs. 1 and 2). Two canopy dependent species, Red-eyed Vireo (*Vireo olivaceus*) and Blue-gray Gnatcatcher (*Polioptila caerulea*), were most numerous in this tract (Fig. 3). This tract was highest in forest area size.

Area 2 (undisturbed) — Samplings of canopy cover and understory density revealed a forest with a similar structure and area size as the logged tract of area 3 (Figs. 1 and 2). Sampling in 1985 and 1991 recorded the most species and individuals of any of the four tracts (Tables 1 and 2).

Area 3 (logged) — The 1985 and 1991 bird counts recorded the fewest individuals. In contrast, the 1990 bird census registered the highest number of individuals heard or seen (Tables 1 and 2).

Area 4 (logged) — The more intensive logging of this tract was reflected in its canopy cover (Fig. 1). However, the understory density did not correlate with the canopy breaks and can probably be attributed to two spring wildfires. Several edge species were more numerous in this tract, i.e. Eastern Bluebird (*Sialia sialis*) and Common Yellow-throat (*Geothlypis trichas*).

PERCENT CANOPY COVER

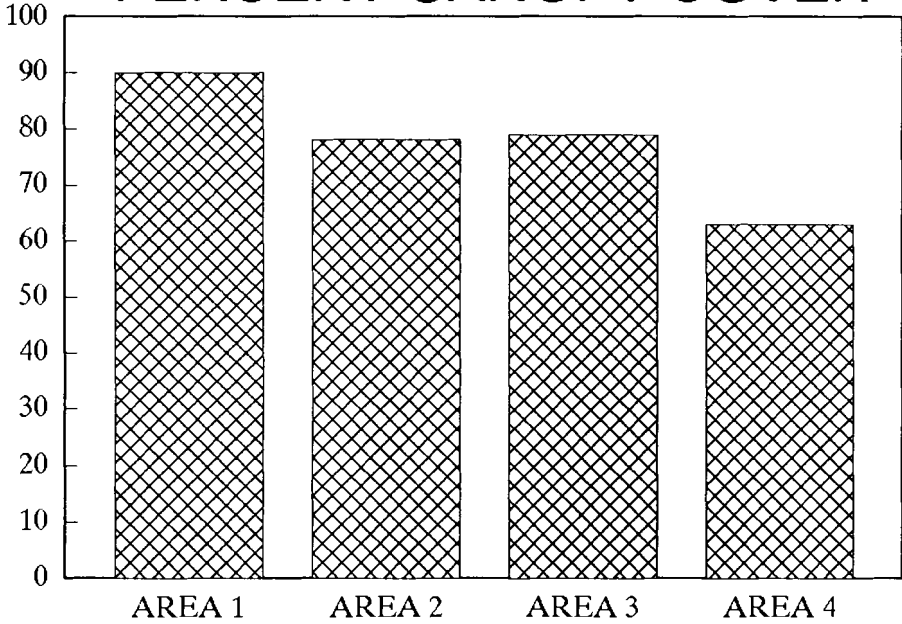


FIGURE 1. PERCENT CANOPY COVER — Percent canopy cover is based on sampling within the 3–0.04 ha circular plots in each tract.

DENSITY OF UNDERSTORY

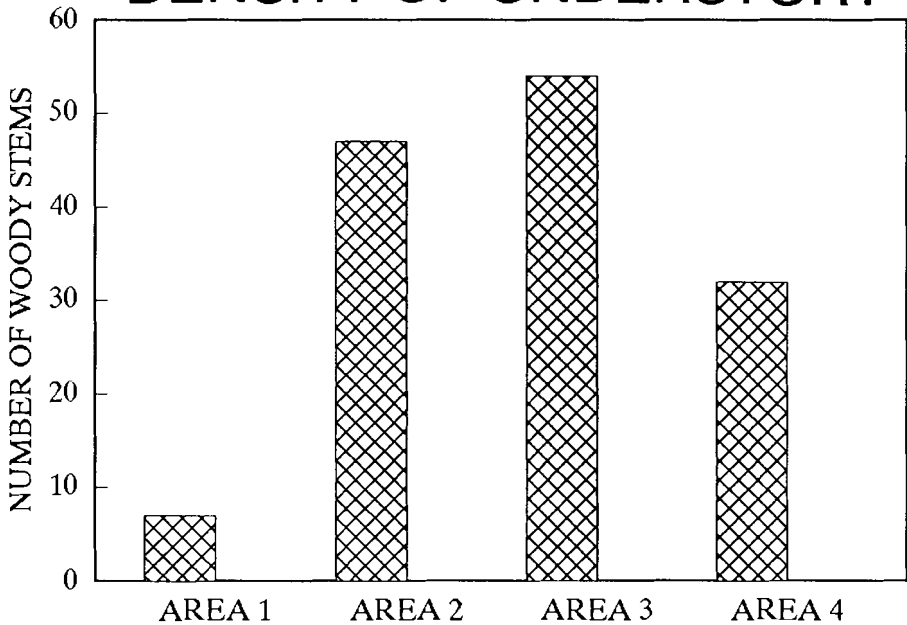


FIGURE 2. DENSITY OF UNDERSTORY — Density of understory was determined by counting the number of woody stems intersected on line transects within the 0.04 circular plots.

CANOPY DEPENDENT SPECIES

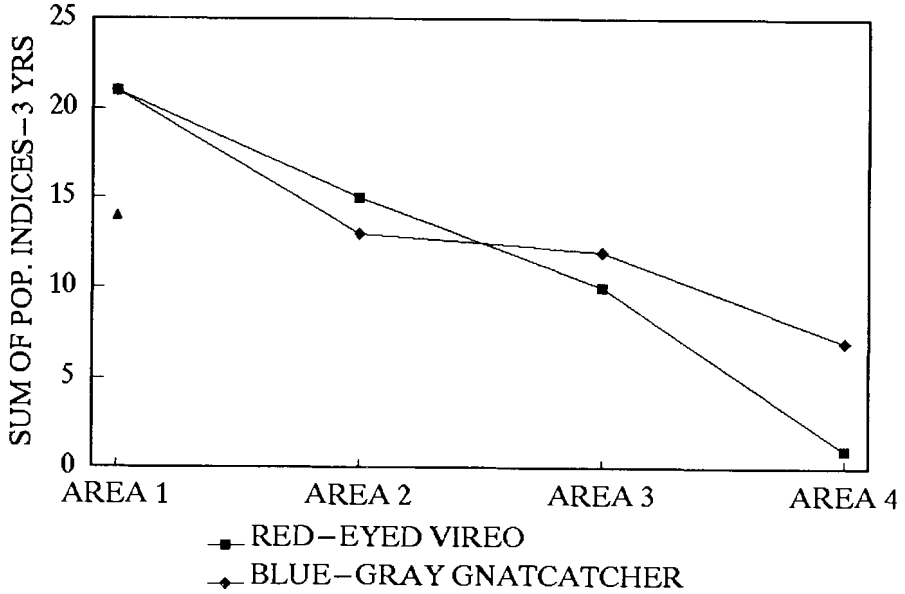


FIGURE 3. CANOPY DENSITY SPECIES — Correlation between logged sites vs. unlogged sites in regard to canopy dependent species.

BREEDING BIRD DIVERSITY

RICHNESS AND EVENESS OF BIRD POPULATION

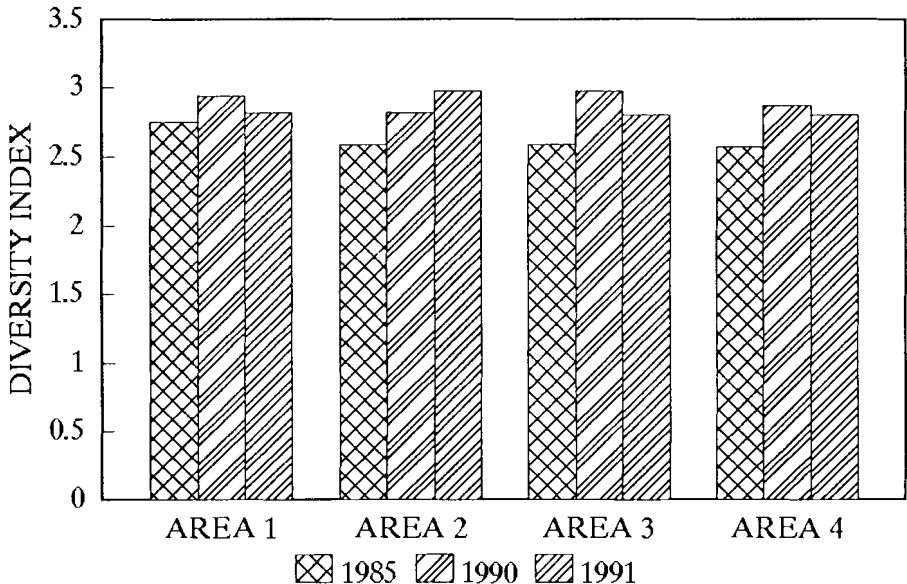


FIGURE 4. BREEDING BIRD DIVERSITY — Bird diversity was determined by using the Shannon-Weaver index.

TABLE 1
1990-91 species abundance based on population indexing.

Species	Tracts		1		2		3		4	
	'90	'91	'90	'91	'90	'91	'90	'91	'90	'91
Northern Bobwhite (<i>Colinus virginianus</i>)	-	-	-	-	1	-	-	-	-	-
Black-billed Cuckoo (<i>Coccyzus erythrophthalmus</i>)	1	-	-	1	1	-	-	-	-	-
Yellow-billed Cuckoo (<i>Coccyzus americanus</i>)	2	3	3	3	4	3	3	2		
Great-horned Owl (<i>Bubo virginianus</i>)	-	1	-	-	-	-	-	-	-	-
Barred Owl (<i>Strix varia</i>)	2	-	-	-	-	-	-	-	-	-
Ruby-throated Hummingbird (<i>Archilochus colubris</i>)	2	-	-	-	-	-	-	-	-	-
Red-headed Woodpecker (<i>Melanerpes erythrocephalus</i>)	1	1	6	2	2	1	2	2		
Red-bellied Woodpecker (<i>Melanerpes carolinus</i>)	7	6	5	6	5	4	4	6		
Downy Woodpecker (<i>Picoides pubescens</i>)	1	3	4	4	2	2	4	3		
Hairy Woodpecker (<i>Picoides villosus</i>)	-	-	1	-	-	-	-	-	-	-
Northern Flicker (<i>Colaptes auratus</i>)	-	-	-	-	-	-	-	-	-	-
Pileated Woodpecker (<i>Dryocopus pileatus</i>)	-	-	1	-	-	-	-	-	-	-
Eastern Wood-pewee (<i>Contopus virens</i>)	3	2	3	2	4	3	3	3		
Acadian Flycatcher (<i>Empidonax virescens</i>)	2	-	-	-	-	-	-	-	-	-
Great-crested Flycatcher (<i>Myiarchus crinitus</i>)	4	6	7	6	6	4	5	5		
Blue Jay (<i>Cyanocitta cristata</i>)	2	1	1	2	2	1	4	1		
American Crow (<i>Corvus brachyrhynchos</i>)	4	9	-	3	2	3	-	2		
Carolina Chickadee (<i>Parus carolinensis</i>)	4	5	7	7	6	5	6	5		
Tufted Titmouse (<i>Parus bicolor</i>)	7	3	5	6	7	3	3	4		
White-breasted Nuthatch (<i>Sitta carolinensis</i>)	4	7	2	3	5	5	6	7		
Carolina Wren (<i>Thryothorus ludovicianus</i>)	1	5	4	3	2	3	4	3		
House Wren (<i>Troglodytes aedon</i>)	-	-	-	-	1	-	1	-		
Blue-gray Gnatcatcher (<i>Poliopitila caerulea</i>)	7	6	6	6	6	6	3	4		
Eastern Bluebird (<i>Sialia sialis</i>)	-	3	-	2	-	-	5	3		
Brown Thrasher (<i>Toxostoma rufum</i>)	-	-	-	1	-	-	-	-		
Red-eyed Vireo (<i>Vireo olivaceus</i>)	5	6	3	5	5	3	1	-		
Northern Parula (<i>Parula americana</i>)	2	1	1	4	1	2	-	1		
Prothonotary Warbler (<i>Protonotaria citrea</i>)	1	-	-	-	1	-	1	-		
Kentucky Warbler (<i>Oporornis formosus</i>)	-	-	1	1	1	-	1	-		
Common Yellow-throat (<i>Geothlypis trichas</i>)	-	-	-	-	-	-	1	-		
Scarlet Tanager (<i>Piranga olivacea</i>)	-	-	-	1	-	-	-	1		
Northern Cardinal (<i>Cardinalis cardinalis</i>)	6	8	7	7	6	7	6	6		
Indigo Bunting (<i>Passerina cyanea</i>)	6	4	3	4	4	5	4	5		
Brown-headed Cowbird (<i>Molothrus ater</i>)	2	3	3	4	5	1	2	2		
Number of individuals	1990:	76	73	80	68					
	1991:	83	82	62	65					
Total number of species	1990:	23	20	24	20					
	1991:	20	23	19	19					

The only species to show significant correlation between logged and undisturbed sites were the Red-eyed Vireo and Blue-gray Gnatcatcher (Fig. 3). Both species reacted negatively to the lack of canopy. Other interior specialists like the Pileated Woodpecker (*Dryocopus pileatus*) did not show a strong preference for either area size or canopy cover. The Pileated Woodpecker, a wide ranging species (Whitcomb et al. 1977), may have utilized other tracts in the vicinity minimizing the effects of logging on one small forest. However, the Acadian Flycatcher (*Empidonax virescens*) found only on area 1, may not be able to utilize other connected tracts as effectively. Perhaps more important than the status of interior species was the failure of edge species to profit significantly from logging.

TABLE 2
1990-91 Species Abundance

Because the 1985 census did not contain sufficient data for population indexing, species abundance is based on the highest total count of birds during one of the two census day.

Species	Tracts	Undisturbed		Logged	
		1	2	3	4
Wild Turkey (<i>Meleagris gallopavo</i>)		-	1	-	-
Northern Bobwhite (<i>Colinus virginianus</i>)		2	-	-	-
*Killdeer (<i>Charadrius vociferus</i>)		-	1	-	-
Yellow-billed Cuckoo (<i>Coccyzus americanus</i>)		-	14	8	3
*Red-headed Woodpecker (<i>Melanerpes erythrocephalus</i>)		9	13	11	13
Red-bellied Woodpecker (<i>Melanerpes carolinus</i>)		-	-	-	1
Downy Woodpecker (<i>Picoides pubescens</i>)		2	-	2	-
Hairy Woodpecker (<i>Picoides villosus</i>)		1	-	2	-
Northern Flicker (<i>Colaptes auratus</i>)		3	2	1	-
Pileated Woodpecker (<i>Dryocopus pileatus</i>)		3	-	-	1
Eastern Wood-pewee (<i>Contopus virens</i>)		8	4	6	10
Eastern Phoebe (<i>Sayornis phoebe</i>)		1	-	-	-
Great-crested Flycatcher (<i>Myiarchus crinitus</i>)		4	-	5	2
*Western Kingbird (<i>Tyrannus verticalis</i>)		-	-	-	2
Blue Jay (<i>Cyanocitta cristata</i>)		3	3	2	4
American Crow (<i>Corvus brachyrhynchos</i>)		3	1	2	2
Carolina Chickadee (<i>Parus carolinensis</i>)		3	4	7	-
Tufted Titmouse (<i>Parus bicolor</i>)		6	9	4	7
White-breasted Nuthatch (<i>Sitta carolinensis</i>)		4	5	4	2
Carolina Wren (<i>Thryothorus ludovicianus</i>)		-	2	-	-
House Wren (<i>Troglodytes aedon</i>)		-	-	-	4
Blue-gray Gnatcatcher (<i>Poliophtila caerulea</i>)		8	1	-	-
Eastern Bluebird (<i>Sialia stalis</i>)		-	-	-	2
Brown Thrasher (<i>Toxostoma rufum</i>)		-	1	1	-
Red-eyed Vireo (<i>Vireo olivaceus</i>)		10	7	2	-
Prothonotary Warbler (<i>Protonotaria citrea</i>)		-	1	1	-
Northern Cardinal (<i>Cardinalis cardinalis</i>)		11	15	12	15
Indigo Bunting (<i>Passerina cyanea</i>)		4	5	1	2
Brown-headed Cowbird (<i>Molothrus ater</i>)		-	-	-	5
Northern Oriole (<i>Icterus galbula</i>)		-	-	-	5
Unknown		5	3	3	9
Number of individuals		69	67	89	99
Total number of species (Unknown not included)		18	19	17	17
*Species identification questionable					

DISCUSSION

Tree-fall gaps are important microhabitats to migrant insectivores because they support an abundance of phytophagous insects (Blake and Hoppes 1986). Logging can mimic natural tree-fall gaps resulting in an increase in food resources for birds and other wildlife. It has been shown in other studies that this increase in food resources is positive to avian abundance. Ambuel and Temple (1983) found bird densities highest where a canopy allows growth of lower vegetation. Chadwick et al. (1986) found that fuelwood harvested forests in New England were more diverse in both bird populations and vegetation than uncut sites. Webb et al. (1977) noted a definite increase in the number of birds in logged sites after a period of three years. And as a result of tree removal in Maryland, Whitcomb et al. (1977) encountered significant numbers of edge

species as well as certain interior species.

While logging disturbances may duplicate natural canopy gaps, excessive cutting may fragment a forest. This fragmentation is beneficial to many forest generalists and edge species, but some interior specialists are restricted to large unfragmented forests (Ambuel and Temple 1983, Blake and Karr 1987). Galli et al. (1989) supported this, finding that some species require a forest interior environment not found in small fragmented forests. In a study of breeding birds in the middle Atlantic states in which 75 species were sampled, Robbins et al. (1989) found none that were restricted to small fragmented forests. Fragmentation is also responsible for an increase in nest parasitism and predation (Brittingham and Temple 1983).

Establishing the point at which logging or other disturbances become detrimental to sensitive forest specialists is an important management question. Many variables are involved including the area size of a forest, its composition and maturity, and the scope of disturbances. There are two other factors important in influencing a forest's ability to withstand fragmentation. One is the shape of a forest which determines the amount of edge versus interior of a tract. Robbins et al. (1989) concluded that the forest interior is the single most important part of a forest preserve. Because a square block of forest contains more interior than a narrow forest of equal size, it can probably withstand more disturbances. The second factor, forest isolation, can influence the importance of area size. Blake and Karr (1987) found that area size of isolated Illinois woodlots were responsible for 87-98 percent of the variation in species abundance in comparison to about 50 percent in forests that were not isolated. This suggests that species variation in riparian forests are less dependent on area than isolated tracts. But according to Robbins et al. (1989), a single large tract is still more favorable to forest-interior species than smaller connected tracts.

In this study, the lack of differences in breeding bird composition and diversity between tracts may be partly a result of the study areas' forest shape and their proximity to other forests. Since the study tracts are all generally narrow, creating more edge may have less impact than in a larger block-shaped forest. The small differences in the more sensitive species may be explained in the habitat requirements of these species being met by adjoining forests.

MANAGEMENT IMPLICATIONS

In the past, creating edge has been the doctrine of wildlife management. This practice is beneficial to many species, but has largely ignored many species that depend on unfragmented habitats. While this study has not shown a dramatic negative response to logging, more emphasis should be placed on the protection of forest interior. This statement is based on the study showing that logging failed to add appreciative gains to edge species and more importantly, forest interior is a scarce resource in comparison to edge in eastern Kansas. The management of forest resources in Kansas should focus more on preservation and even enhancement of forest interior. To accomplish this, a resource manager has two options: 1) to preserve the integrity of the interior by restricting disturbances that might fragment the forest; 2) enhancement of the forest interior by reforestation. Good reforestation sites might include filter strips and small isolated fields between forested tracts. If consideration is given for the needs of both edge and interior birds, a more tolerable balance should result.

ACKNOWLEDGEMENTS

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PROBABLE BREEDING OF THE YELLOW-THROATED WARBLER (*DENDROICA DOMINICA*) IN NORTHEAST KANSAS

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We observed Yellow-throated Warblers (*Dendroica dominica*) in the Weston Bend floodplain of the Missouri River at Fort Leavenworth, Leavenworth County, Kansas during the spring of 1990 and 1991. Breeding evidence of this species had not been previously reported in northeast Kansas (Thompson and Ely 1992). New sightings in early April, 1991, caused us to initiate a study to locate and estimate territory size, verify pair formation, and confirm nesting at Fort Leavenworth. This warbler was also observed in northwest Missouri and southeast Nebraska and we have included a summary of its distribution for this portion of the Missouri River basin.

STUDY AREA AND METHODS

The Weston Bend floodplain, in the northeast portion of the Fort Leavenworth Military Reservation, is about 600 hectares. The floodplain forest has been partly converted to farmland or has been cleared. The remaining forest is located near the stream channel of the Missouri River where periodic flooding can occur. Tree species common in the mature hardwood forest are hackberry (*Celtis occidentalis*), walnut (*Juglans nigra*), sycamore (*Plantanus occidentalis*), green ash (*Fraxinus pennsylvanica*), bur oak (*Quercus macrocarpa*), and pecan (*Carya illinoensis*). Pawpaw (*Asimina triloba*), horsetail (*Equisetum sp.*) and nettle (*Urtica dioica*) make up much of the understory.

In 1990 Yellow-throated Warblers were first sighted on 28 April and last observed on 19 May. During April 1991 we regularly observed this warbler and established a 3200 m census trail. After each census individuals or pairs were plotted on a scale map. A minimum of four sightings, a week or more apart, in a given area were considered a territory. The limits of a territory were determined by census comparison. There were other scattered sightings which failed to meet these criteria and these data are not included.

RESULTS AND DISCUSSION

Yellow-throated Warblers were sighted on 5 April and, based on previous records (Thompson and Ely 1992), this is an early arrival date for Kansas. This species occurred for the most part in mature sycamores with occasional sightings in other deciduous trees. Figure 1 shows the distribution of territories. On 4 July, nine individuals were found in the study area. Six of these occurred in territories A through E, an area where the density of sycamores is high. On 22 July three individuals were found (one by sight and two by song) in territory D, but the age and sex could not be determined. Although we observed single and paired birds from 5 April through 22 July, we found no direct evidence of nesting.

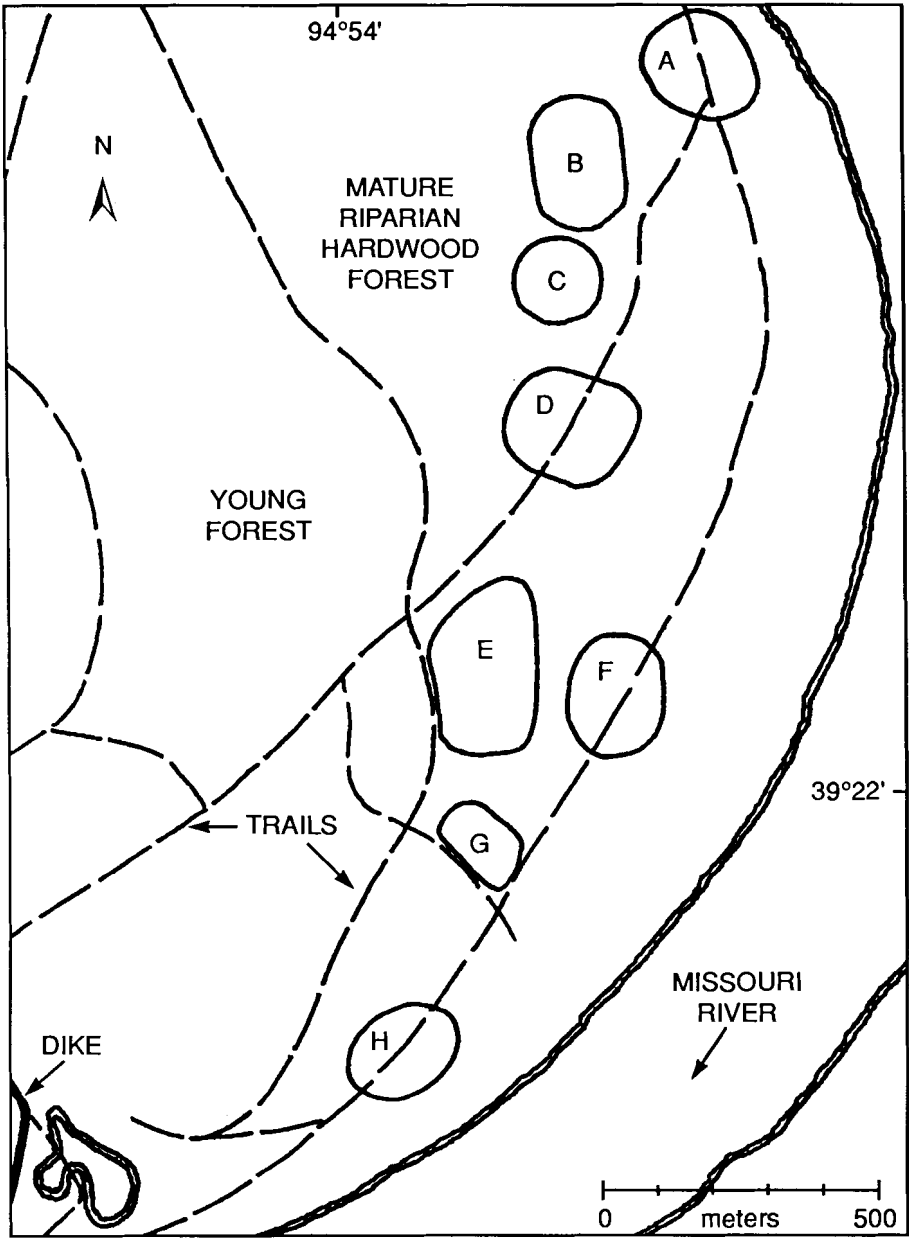


FIGURE 1. Map of Weston Bend floodplain forest at Fort Leavenworth, Kansas, showing the distribution of Yellow-throated Warbler territories indicated by letters A-H.

Emlen (1977) describes some problems of procedure and interpretation using the plot map method. Some of these include: double recording of individual birds, determination of territory boundaries, data collection by multiple observers and changes in individual bird location between visits. Double recording of individual birds did not seem to be a

problem in this study since neighboring males, at times, sang concurrently where territories were nearly contiguous. Determination of territorial boundaries was difficult, (especially A, C, E, and G) due to interpretive variation among four observers, the inability to track birds in the forest canopy while walking through dense ground cover, and inconsistent observations or shifts in the location of birds throughout the breeding season. These inconsistent observations may be due to a decline in singing as the breeding season progressed. Bent (1953) remarked that only an occasional song is heard as June approaches. Aural and visual observations were the most consistent at the isolated location H where we estimated a territory size of 1.6 hectares.

On 13 April we found a Yellow-throated Warbler across the Missouri River in the upland forest at Weston Bend State Park, Platte County, Missouri. Another was seen on 17 May in Richardson County, Nebraska, at the junction of the Big Nemaha and Missouri rivers. We did not find this species in the floodplain forest remnants along the Missouri River in Atchison County, Kansas or adjacent Buchanan County, Missouri. Part of the forest here had recently been destroyed and converted to cropland.

The A.O.U. Checklist (1983) describes the Yellow-throated Warbler's breeding distribution in the central portion of the United States as "... from central Oklahoma, southeastern Kansas, central Missouri and extreme southeastern Iowa ..." and later adds that it "formerly bred north to northern Missouri."

Thompson and Ely (1992) consider it a rare transient in the easternmost tier of Kansas counties from 15 April to 30 September, and a locally rare breeder in extreme southeast Kansas. There is one confirmed nesting record (Schwilling, et al. 1981) from southeast Kansas in Cherokee County. It may also breed in Linn County (ibid) on the eastern border of Kansas 120 km south of Leavenworth. Charles A. Ely (pers. comm.) has reports of 8 sightings from Johnson County since 1964, which borders Leavenworth County on the south. The 28 April 1990 sighting is the first published for Leavenworth County.

In northwest Missouri, Robbins and Easterla (1991) describes the status of the Yellow-throated Warbler as "very rare or absent". It bred in Andrew County in the early 1970's, and more recently can only be found north and west to Grundy and Buchanan counties, respectively. Wilson and Jacobs (1991) remarked that the Yellow-throated Warbler's distribution was thought to be generally restricted to the southern part of the state; however, preliminary mapping of (atlasing) breeding birds suggests a more scattered distribution, but there is no breeding evidence reported north or west of those sites listed by Robbins and Easterla (1991).

Johnsgard (1979a, 1979b) lists this warbler as a hypothetical breeder in Nebraska because it was "reported without apparent justification to be a rare breeder in southeast." In addition to our observations in Richardson County, it has also been reported in several other southeast Nebraska counties listed in the Nebraska Bird Review from the past 10 years. Babs Padelford (pers. comm.) observed this warbler on 7 occasions from 20 April to 18 July, 1991, in Fontenelle Forest, Sarpy County. She heard an additional three birds singing and a fourth carrying nest material on 4 May, 1989.

In Iowa, Dinsmore et al. (1984) reported records, including one nesting record, from the Des Moines and Mississippi River courses but none from the Missouri River drainage in the southwest part of the state.

Studies (Bent 1953, Johnston 1965, Schwilling et al. 1981, Dinsmore et al. 1984, Thompson and Ely 1992) of the Yellow-throated Warbler in the central part of the United States show a close relationship between the presence of this bird and riparian forests with mature sycamores. Bent (1953) remarked that as sycamores have disappeared, these warblers have become scarce or have gone entirely. The bottomland of Weston Bend is probably the best example of mature riparian forest in Kansas and western Missouri (Zimmerman and Patti 1988). Our findings document the "probable" breeding of a small population of Yellow-throated Warblers in this forest, an area of Kansas where it had not been previously reported. Continued preservation of this unique habitat will sustain the potential for breeding.

ACKNOWLEDGEMENTS

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Pyrrhuloxia (*Cardinalis sinautus*), A New Bird For Kansas — While observing birds in the mid-morning of 6 November 1989, we flushed a bird from near the barn at the U.S. Forest Service work station four miles north of Elkhart, Morton County, Kansas. While superficially resembling a Northern Cardinal (*Cardinalis cardinalis*), the bird seemed to Patti to have some gray in its plumage, and have a slightly different call note from that of a Northern Cardinal. The bird was again located and after careful observation, we concluded that the bird was a female Pyrrhuloxia, a new species for the State of Kansas.

The bird was a mouse gray brown bird with amounts of red in the primaries and the tail feathers, which was noticeable when the bird flew. The crest had a small amount of red at the tip, and the breast area was also smudged with some red. The most noticeable field mark of this bird was the horn-colored bill with a noticeably decurved culmen.

Through the month of November, many observations were able to relocate and observe this bird. It is unknown when the last observation of the live bird was made. We returned to the site on 29 December 1989 and found feathers of a cardinal-like bird in the barn. The feathers were collected and brought back to Southwestern College where they were compared with Pyrrhuloxias in the collection. The feathers were clearly those of a female. The cause of death is unknown, but the feathers had clearly been removed from the carcass by either a sharp knife or scissors. The feathers were placed in the Southwestern College Museum of Natural History (catalog No. 8380).

The appearance of the Pyrrhuloxia is not unexpected. The bird has been previously seen in the Oklahoma Panhandle (Patti, Sebastian. *Oklahoma Orni. Soc. Bull.* 19:16). The bird is in the Texas Panhandle in the vicinity of Amarillo (Kenneth Seyffert, pers.

comm.). Colorado recorded its first *Pyrrhuloxia* the same winter, when a bird was discovered on the Holly Christmas Count (American Birds, 44:907). *Sebastian Patti*, % *US EPA*, 230 S. Dearborn St., Chicaco, IL 60604; *Max C. Thompson*, Southwestern College, Winfield, KS 67156.

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